Appl. No.: 10/693,823
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Amendments to the Claims:

CLAIMS

We claim:

1. (Currently amended) A system for detecting sounds at a wide range of frequencies including sounds of audible frequencies, comprising at least one beam of high frequency, which is distorted by the sound waves, so that the created distortions can be detected, wherein at least one of:
   a. Said at least one beam of high frequency is not a beam of light and ~~wherein~~ the frequency of said at least one beam is higher than the frequency of said sound waves, and ~~wherein~~ said system is adapted to be used as a microphone for detection of sounds, and the microphone is at least partially directional by at least 1 of: 1. Putting the sensors inside a small acoustic tube, so that the tube itself allows more sounds to come in from its front than from its sides, 2. Using a number of sensors and/or a number of high frequency sources inside the microphone, so that by taking into account the differential effect on them, the direction of the sound can be determined and sounds from unwanted directions can be cancelled out, 3. Using a Fourier transform in order to filter directions;
   b. Said at least one beam of high frequency is not a beam of light and the frequency of said at least one beam is higher than the frequency of said sound waves, and said system is adapted to be used as a microphone for detection of sounds, and the detection of said distortions is by at least one of: phase shift detection, frequency shift detection, detection of distortions in an

interference pattern between at least two radiation sources, using an interferometer, detecting amplitude distortions, using a feedback loop that changes the transmitted frequency, using at least two baseline high-frequency signals, one that is isolated from the sound and one that is exposed to the sound, so that they can be compared, and/or comparing the frequency which is exposed to the sound with a pre-stored digital representation of the original undistorted base high frequency;

c. Said at least one beam is a beam of light and the detected distortions are detected by trapping particles or ionized gas inside an enclosure and measuring the changes in light caused by the movements of the particles caused by the sound.

2. (Currently amended) The system of claim 1 wherein at least one of:
   a. Said higher frequency is electromagnetic radiation and the detected distortions are at least one of phase shift, frequency shift, distortions in an interference pattern between at least two radiation sources, and any other detectable distortion, or combinations of them;
   b. Said higher frequency is ultrasound and the detected distortions are at least one of phase shift, frequency shift, amplitude shifts, distortions in an interference pattern between at least two ultrasound beams, and any other detectable distortion, or combinations of them;
   c. Said higher frequency is light and the detected distortions are detected by trapping particles or ionized gas inside an enclosure and measuring the changes in light caused by the movements of these minute particles caused by the sound.

3. (Previously amended) The system of claim 2 wherein said higher frequency is ultrasound and said ultrasound is transmitted and detected

by at least one of Quartz crystals, Piezoelectric ultrasonic sensors, and MEMS sensors, and/or by any other known means for creating or detecting ultrasonic waves.

4. (Currently amended) The system of claim 2 wherein at least one of the following features exists:
    a. There is an air gap between the transmitter and the receiver wherein said gap is small enough to detect just 1 peak of the sound waves;
    b. The high frequency is considerably higher than the frequency of the detected sounds;
    c. The high frequency used is as high as possible in order to improve the resolution and sensitivity by increasing the number of peaks of the high frequency signal within the gap;
    d. The high frequency signals are consecutive;
    e. The high frequency signals are based on pulses;
    f. The at least one high frequency is emitted all the time that the microphone is turned on;
    g. The at least one high frequency is activated or increased from lower levels only when the microphone senses that a sound has entered the system;
    h. The detection is based on at least phase shifting detection, and the distortions are converted to the detected sound frequency by at least one of: deleting the phase-shifted signal from the base reference frequency, using an interferometer, and using a feedback loop that changes the transmitted frequency;
    i. <u>At least two baseline high-frequency signals are used, one that is isolated from the sound and one that is exposed to the sound, so that they can be compared;</u>

j. Only one frequency is exposed to the sound and is compared to a digital representation of the original undistorted base high frequency that is pre-stored;

k. A frequency which is exposed to the sound is compared with a pre-stored digital representation of the original undistorted base high frequency;

l. A normal interference pattern between one or more ultrasonic signals is used as reference baseline, and distortions are detected as deviations from this interference pattern caused by normal sound waves in the air;

~~i.~~m. The detected sound is further transferred by the system as digital signals;

~~j.~~n. The detected sound is further transferred by the system as analogue signals which are encoded by at least one of frequency modulation and Pulse Width Modulation.

5. (Currently amended) The system of claim 1 wherein at least one of the following features exists:

a. The microphone is naturally at least partially directional by putting the sensors inside at least one of an acoustic tube and parabolic sound reflector;

b. The microphone can be made directional by using at least one of a number of sensors and a number of high frequency sources inside the microphone, so that by taking into account the differential effect on them, the direction of the sound can be determined, and sounds from unwanted directions can be cancelled out;

c. At least one of the directionality of the microphone and the actual direction chosen can be flexibly changed by the user;

d. The directionality can be flexibly changed by the user by changing the sensors and transmitters depth within acoustic walls;

e. The directionality can be flexibly changed electronically;

f. A number of types of pairs are used within each surface or at different surfaces, or more sensors than transmitters, so that the farther sensors are used for sensing lower frequencies and the smaller pair gaps are used for sensing higher frequencies;

~~e.~~g. The microphone is able to automatically filter out undesired frequencies according to the speed of the distortions;

~~f.~~h. Low frequencies caused by air flows are automatically filtered out.

6. (Previously amended) The system of claim 1 wherein at least one of the following features exist:

   a. Interference patterns created between at least two high frequency sources can be used to create lower-frequencies and volumes desired;

   b. For reproducing sound at a wide frequency range large arrays of minute membranes are used and vibrated at all desired frequencies, with various combinations of synchronously and separately vibrating membranes.

7. (Previously amended) The system of claim 1 wherein for displaying high frequencies that are hard to hear the too high frequencies can be automatically downshifted to frequencies that can be heard, and at least one of the following features exists:

   a. For displaying high frequencies that are hard to hear the too high frequencies are automatically downshifted to frequencies that can be heard;

b. The user has control on at least one of the range of frequencies to be downshifted, the amount of displacement, and the width of the downshifted frequencies;

c. The downshifting can be used also with recordings, at least one of during the recording and during the playback;

d. Two-way downshifting and up-shifting is used so that low humanly audible frequencies can be at least one of shifted and spread to higher ranges and higher ranges can be shifted to lower ranges;

e. Two-way downshifting and up-shifting is used for communications between humans and animals that can use and hear much higher sound frequencies.

8. (Previously amended) The system of claim 1 wherein each sensor is paired with one transmitter and at least one such pair is used, and at least one of the following features exists:

   a. Each sensor is paired with one transmitter and at least one such pair is used;

   b. The high frequency beam within each pair is very narrow and directional;

   c. The pairs are arranged so that the directions of the beams do not interfere with the other pairs and the distances among the pairs are bigger than the gaps within the pairs;

   d. The sensors and transmitters are suspended inside the microphone in mid-air by wires, so as not to obstruct the passage of lower frequency waves;

   e. Each transmitter-sensor pair is within a hole in some surface so that there is more isolation between the pairs;

   f. More than one surface with sensors and transmitters is used;

g. More than one size of within-pair gaps is used, so that the farther sensors are used for sensing lower frequencies and the smaller pair gaps are used for sensing higher frequencies.

9. (Currently amended) A method for detecting sounds at a wide range of frequencies including sounds of audible frequencies, comprising the steps of at least one of:

   a. Using at least one beam of high frequency, which is distorted by the sound waves, wherein said at least one beam of high frequency is not a beam of light and wherein the frequency of said at least one beam is higher than the frequency of said sound waves; and ~~D~~detecting the created distortions, and using them to detect sound as a microphone, and wherein the microphone is at least partially directional by at least 1 of: 1. Putting the sensors inside a small acoustic tube, so that the tube itself allows more sounds to come in from its front than from its sides, 2. Using a number of sensors and/or a number of high frequency sources inside the microphone, so that by taking into account the differential effect on them, the direction of the sound can be determined and sounds from unwanted directions can be cancelled out, 3. Using a Fourier transform in order to filter directions~~.~~;

   b. Using at least one beam of high frequency, which is distorted by the sound waves, wherein said at least one beam of high frequency is not a beam of light and wherein the frequency of said at least one beam is higher than the frequency of said sound waves, and wherein said system is adapted to be used as a microphone for detection of sounds, and wherein the detection of said distortions is by at least one of: phase shift detection, frequency shift detection, detection of distortions in an interference pattern between at least two radiation sources, using

an interferometer, detecting amplitude distortions, using a feedback loop that changes the transmitted frequency, using at least two baseline high-frequency signals, one that is isolated from the sound and one that is exposed to the sound, so that they can be compared, and/or comparing the frequency which is exposed to the sound with a pre-stored digital representation of the original undistorted base high frequency;

c. Using at least one beam of light and detecting distortions are by trapping particles or ionized gas inside an enclosure and measuring the changes in light caused by the movements of the particles caused by the sound.

10. (Currently amended) The method of claim 9 wherein at least one of:

a. Said higher frequency is electromagnetic radiation and the detected distortions are at least one of phase shift, frequency shift, distortions in an interference pattern between at least two radiation sources, and any other detectable distortion, or combinations of them;

b. Said higher frequency is ultrasound and the detected distortions are at least one of phase shift, frequency shift, amplitude shifts, distortions in an interference pattern between at least two ultrasound beams, and any other detectable distortion, or combinations of them;

c. Said higher frequency is light and the detected distortions are detected by trapping particles or ionized gas inside an enclosure and measuring the changes in light caused by the movements of these minute particles caused by the sound.

11. (Previously amended) The method of claim 10 wherein said higher frequency is ultrasound and said ultrasound is transmitted and detected by at least one of Quartz crystals, Piezoelectric ultrasonic sensors, and

MEMS sensors, and/or by any other known means for creating or detecting ultrasonic waves.

12. (Currently amended) The method of claim 10 wherein at least one of the following features exists:
    a. There is an air gap between the transmitter and the receiver wherein said gap is small enough to detect just 1 peak of the sound waves;
    b. The high frequency is considerably higher than the frequency of the detected sounds;
    c. The high frequency used is as high as possible in order to improve the resolution and sensitivity by increasing the number of peaks of the high frequency signal within the gap;
    d. The high frequency signals are consecutive;
    e. The high frequency signals are based on pulses;
    f. The at least one high frequency is emitted all the time that the microphone is turned on;
    g. The at least one high frequency is activated or increased from lower levels only when the microphone senses that any sound has entered the system;
    h. The detection is based on at least phase shifting detection, and the distortions are converted to the detected sound frequency by at least one of: deleting the phase-shifted signal from the base reference frequency, using an interferometer, and using a feedback loop that changes the transmitted frequency;
    i. At least two baseline high-frequency signals are used, one that is isolated from the sound and one that is exposed to the sound, so that they can be compared;
    j. Only one frequency is exposed to the sound and is compared to a digital representation of the original undistorted base high frequency that is pre-stored;

k. A frequency which is exposed to the sound is compared with a pre-stored digital representation of the original undistorted base high frequency;

l. A normal interference pattern between one or more ultrasonic signals is used as reference baseline, and distortions are detected as deviations from this interference pattern caused by normal sound waves in the air;

~~i.~~m. After detection, the detected sound is transferred as digital signals;

~~j.~~n. After detection, the detected sound is transferred as analogue signals which are encoded by at least one of frequency modulation and Pulse Width Modulation.

13. (Currently amended) The method of claim 9 wherein at least one of the following feature exists:

a. The microphone is naturally at least partially directional by putting the sensors inside at least one of an acoustic tube and parabolic sound reflector;

b. The microphone can be made directional by using at least one of a number of sensors and a number of high frequency sources inside the microphone, so that by taking into account the differential effect on them, the direction of the sound can be determined, and sounds from unwanted directions can be cancelled out;

c. At least one of the directionality of the microphone and the actual direction chosen can be flexibly changed by the user;

d. The directionality can be flexibly changed by the user by changing the sensors and transmitters depth within acoustic walls;

e. The directionality can be flexibly changed electronically;

f. A number of types of pairs are used within each surface or at different surfaces, or more sensors than transmitters, so that the farther sensors are used for sensing lower frequencies and the smaller pair gaps are used for sensing higher frequencies;

~~e.~~g. The microphone is able to automatically filter out undesired frequencies according to the speed of the distortions;

~~f.~~h. Low frequencies caused by air flows are automatically filtered out.

14. (Previously amended) The method of claim 9 wherein at least one of the following features exist:
    a. Interference patterns created between at least two high frequency sources can be used to create lower-frequencies and volumes desired;
    b. For reproducing sound at a wide frequency range large arrays of minute membranes are used and vibrated at all desired frequencies, with various combinations of synchronously and separately vibrating membranes.

15. (Previously amended) The method of claim 9 wherein for displaying high frequencies that are hard to hear the too high frequencies can be automatically downshifted to frequencies that can be heard, and at least one of the following features exists:
    a. For displaying high frequencies that are hard to hear the too high frequencies are automatically downshifted to frequencies that can be heard;
    b. The user has control on at least one of the range of frequencies to be downshifted, the amount of displacement, and the width of the downshifted frequencies;
    c. The downshifting can be used also with recordings, at least one of during the recording and during the playback;

d. Two-way downshifting and up-shifting is used so that low humanly audible frequencies can be at least one of shifted and spread to higher ranges and higher ranges can be shifted to lower ranges;
e. Two-way downshifting and up-shifting is used for communications between humans and animals that can use and hear much higher sound frequencies.

16. (Previously amended) The method of claim 9 wherein each sensor is paired with one transmitter and at least one such pair is used, and at least one of the following features exists:
    a. Each sensor is paired with one transmitter and at least one such pair is used;
    b. The high frequency beam within each pair is very narrow and directional;
    c. The pairs are arranged so that the directions of the beams do not interfere with the other pairs and the distances among the pairs are bigger than the gaps within the pairs;
    d. The sensors and transmitters are suspended inside the microphone in mid-air by wires, so as not to obstruct the passage of lower frequency waves;
    e. Each transmitter-sensor pair is within a hole in some surface so that there is more isolation between the pairs;
    f. More than one surface with sensors and transmitters is used;
    g. More than one size of within-pair gaps is used, so that the farther sensors are used for sensing lower frequencies and the smaller pair gaps are used for sensing higher frequencies.

17. (Previously canceled).

18. (Previously amended) A system for reproducing sound in a wide range of frequencies comprising at least one of:
    a. Large arrays of minute membranes and/or elements which are vibrated at all desired frequencies, with various combinations of synchronously and separately vibrating membranes;
    b. Freely moveable smaller elements connected to one or more larger elements, which are vibrated by at least one transducer, so that the entire bunch of elements vibrate together without having to apply a separate transducer for each of them;
    c. At least one vibrating element with free edges wherein at least one of its corners and/or edges are shaped like fractals, so that each corner can branch into additional corners in one or more planes.

19. (Previously amended) The system of claim 18 wherein interference patterns created between at least two high frequency sources are used to create lower-frequencies and volumes desired, and at least one of the following features exists:
    a. The interference is based on at least one of phase shifting, frequency shifting, and amplitude shifting;
    b. The high frequency sources used are ultrasonic frequencies close to the natural resonance frequency of the minute membranes in order to increase the overall efficiency of the process;
    c. The frequencies that are created are mixed together in at least one of a hollow resonance box, a hyperbolic reflector, and a parabolic reflector.

20. (Previously canceled).

21. (Previously amended) The system of claim 18 wherein large arrays of minute membranes and/or elements are used and vibrated at all desired

frequencies, with various combinations of synchronously and separately vibrating membranes, and at least one of the following features exists:

a. For higher frequencies fewer membranes are vibrated and for lower frequencies more membranes are vibrated together in synchrony in order to create a simulation of a larger membrane;
b. The frequencies that are created are mixed together in at least one of a hollow resonance box, a hyperbolic reflector, and a parabolic reflector;
c. The minute membranes are more solid and are not connected at their circumference to their surrounding and thus can have a displacement range larger than a normal membrane of the same size;
d. At least one of a low friction tunnel and a mesh are used for keeping the vibrated elements in boundaries;
e. For producing sounds in multiple directions the minute membranes and/or elements are on at least one of a wavy and convex surface and/or are pointed at a hyperbolic reflector which reflects back the sound in much more directions.

22. (Previously canceled).

23. (Previously amended) The system of claim 18 wherein freely moveable smaller elements connected to one or more larger elements, which are vibrated by at least one transducer, are used, so that the entire bunch of elements vibrate together without having to apply a separate transducer for each of them, and at least one of the following features exists:

a. Said elements are solid thin plates and said at least one transducer is at least one of magnetic coil or capacitor or Piezo element;
b. Said elements are supported by at least one of wires, needles, arms, strings, and springs;

c. Said elements are supported by at least one of wires, needles, arms, and springs, and said supporting wires and/or needles and/or arms are in a hierarchical structure and/or connected to a wire and/or mesh structure, and/or connected to at least one common center;
d. Electronic pre-correction on the speaker itself is added for taking into account in advance any remaining distortions;
e. A number of transducers are used at different levels of the hierarchy;
f. The elements are not free but are each connected to some frame around it by a few small points of contact;
g. Each point of contact between the elements is based on at least one of a string, a small arm, a needle, and a spring;
h. Each element has a more complex shape at the edges, so as to enable more free vibrations in various frequencies;
i. At least one of the elements is shaped so that at least one of its corners and/or edges are shaped like fractals, so that each corner can branch into additional corners in one or more planes;
j. For producing sounds a hierarchical structure is used, based on starting with a central larger element and recursively attaching to each element smaller elements, and at least one such step of the recursion is used, and the elements are at least one of on the same plane and on more than one plane;
k. At least some of he elements are connected by point connections with strings to a periphery;
l. For producing sounds in multiple directions the elements are on at least one of a wavy and convex surface and/or are pointed at a hyperbolic reflector which reflects back the sound in much more directions;
m. A combination of interconnected solid plates and at least one of soft plates and membranes is used;

n. A dumper is used for blocking elements from continuing the vibration too long after the sound, by at least one of using a resonance box, and using a strong force in at least one of the transducers for helping the elements come to a stop as fast as possible when needed.

24. (Previously canceled).
25. (Previously canceled).
26. (Previously canceled).

27. (Previously amended) The system of claim 18 wherein at least one of the following is used:
    a. At least one fractal-shaped plate which is actuated by at least one Helimorph or similar type of actuator;
    b. Multiple plates which are connected recursively and are actuated by at least one Helimorph or similar type of actuator;
    c. Multiple plates which are connected recursively and the connections themselves are based on Helimorph or similar type of actuators.